



Materials Engineering Branch

TIP*



No. 106 Fracture Prevention of Beryllium Space Flight Structures

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Beryllium is an attractive material for space flight hardware due to its high specific strength (tensile strength/density). There are, however, two aspects of beryllium that mandate special handling: toxicity and susceptibility to damage.

The inhalation of beryllium dust is known to cause berylliosis. Berylliosis is lung inflammation caused by inhaling dust or fumes that contain the metallic element beryllium. The machining of beryllium can not be performed casually and should be performed only in facilities familiar with beryllium risks and equipped to capture the dust generated by the machining processes.

The primary impediment to the usage of beryllium is its propensity to fracture, in a catastrophic manner, when subjected to (apparently) acceptable loads. This behavior has created the perception that beryllium is inherently a brittle material. The cause of this behavior stems from the creation of twins in near-surface grains during machining or abrasion. These twins impede the movement of dislocations and significantly reduce the ductility of beryllium. Thus the beryllium is not capable of dissipating induced loads that would normally be accommodated via plastic deformation.

Special care must be used during the machining of beryllium to minimize the depth of grains containing mechanically induced twins by taking successively smaller and smaller cuts. The remaining layer of twinned material is removed by chemical etching. If tight dimensional tolerances are required, the stress on these surfaces must be well defined. It is important that the surface not be subjected to mechanical abrasion after the etching operation as twins will be re-induced in the surface grains. Even light abrasion, such as the use of 600 grit emery cloth, has been shown to induce twins in surface grains.